Avera McKennan Trauma Service
Trauma Pitfalls – Case Studies

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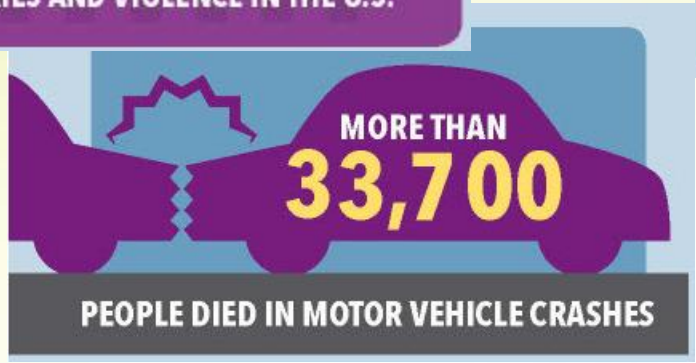
Clinical Nurse Educator

Objectives

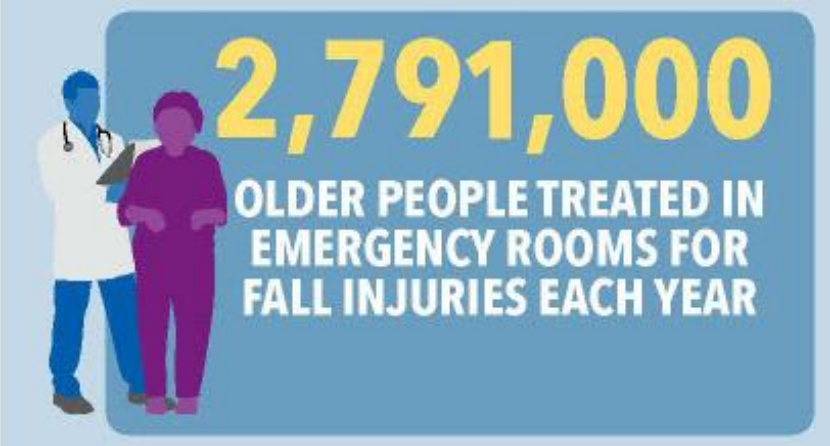
- Identify pitfalls associated with caring for the trauma patient.
- Review the multidisciplinary course of care for the injured patient.
- Review appropriate treatments utilized when caring for the trauma patient.

The Why?



2.5 million hospitalizations

26.9 million ED visits



What is Trauma??

MEDICINE

physical injury.

synonyms: injury, damage, wound; cut, laceration, lesion, abrasion, contusion

"the trauma to the liver"

What do you consider **trauma** at *your* facility??

Definition of a **Trauma Team Alert** patient:

South Dakota Trauma System

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Physiological Absolutes:

Adult:

GCS < 10
BP < 90
Pulse > 120
Respirations < 10 or > 29, or airway obstruction or respiratory compromise requiring use of advanced airway

Child:

The Pediatric Assessment Triangle should be the basis for all pediatric emergencies

Anatomic Absolutes:

- Penetrating injury to chest, abdomen, head, neck
- Limb Paralysis (associated with Trauma)
- Flail Chest
- Amputation proximal to wrist or ankle

Strong degree of suspicion should be used for the following patients, but this does not constitute an automatic categorization of a severe trauma patient:

- Pelvic Fractures
- Falls from 2 times the height of the patient
- Patients involved in high energy MVA's
- Death of an occupant in the same compartment
- Auto-Pedestrian or Auto-Bicycle with impact of greater than 5 MPH
- Pedestrian that was thrown or run-over
- Significant recreational vehicle or farm equipment incident
- Significant injury associated with a large animal

The following **co-morbidities** should also offer a high degree of suspicion

- Age < 5 or > 55
- Pregnancy
- Chronic medical illness

SOUTH DAKOTA DEPARTMENT OF HEALTH

Case Study #1:
MCC

MCC

- ~ 1800: 57 y/o male (driver) & 50 y/o female (passenger) motorcycle vs. pick-up @ 50 mph
  - Not wearing protective leathers
  - Not wearing a helmet
  - Significant lower extremity trauma & bleeding – tourniquets placed per by-standers
  - EMS activated @ 1803

MCC

1812: ALS EMS @ scene

- **Male (1814)**
  - Uncontrolled bleeding from leg – bone sticking out of leg
  - Awake, drowsy – answers questions
  - C-spine held manually per bystander
  - Belt applied as tourniquet
  - Skin clammy, cap refill < 2 seconds
- **Female (1814)**
  - Uncontrolled bleeding from leg – bone sticking out of leg
  - Awake – answers questions
  - C-spine held manually per bystander
  - Belt applied as tourniquet
  - Skin clammy, cap refill < 2 seconds

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- Does this criteria change when you are expecting **2** patients?
- Mass casualty?

MCC: EMS – Male pt.

- 1814: EMS assessment (EBL 1-2 liters)
- 1815: Long board & c-collar, leg straightened
- 1820: GCS 14 – 75/50 – 136 - 25
- 1821: O2 via non-rebreather
- 1825: En route to hospital. Report called – trauma activation
- 1827: Commercial tourniquet applied

Tourniquets

- **Goal**: To control life-threatening vascular hemorrhage from extremity wounds.
- Use when bleeding **cannot** be controlled with direct pressure, there are *multiple wounds* or *you're in need of free hands.*
- May be left on until definitive extremity stability is performed. The longer the application, the higher risk of complication (ischemia, reperfusion injury, compartment syndrome, pain).

Tourniquets

Tourniquets

WHEN EVERY SECOND COUNTS

Despite the proven effectiveness of the Combat Application Tourniquet®, the new C•A•T® GEN7 goes even further toward making it easier and faster to use. All six components of the Combat Application Tourniquet® have been re-designed and improved on the C•A•T® GEN7.

1. SINGLE ROUTING BUCKLE
Decreased blood loss, effective slack removal, fewer windlass turns, simplified training with single protocol application standards

2. WINDLASS ROD
Increased diameter, enhanced strength, aggressive ribbing improves grip

3. WINDLASS CLIP
Bilateral beveled entry, rapid windlass lock, bilateral buttress, added strength

4. WINDLASS STRAP
New reinforced strap, gray color for tactical considerations (Black only)

5. STABILIZATION PLATE
Reinforced, beveled contact bar, improved comfort

6. FREE-MOVING INTERNAL BAND
Patented band within band, truly even distribution of circumferential pressure

MCC: Referring Facility

- 1815: Careflight dispatched
- 1836: Arrives @ facility
  - GCS 13 – bleeding controlled w/tourniquet – neck crepitus – mangled lower extremity
- 1843: IV bilateral hands & IO R)Shoulder – NS bolus x 2 liters
- 1846: Prep for RSI (HR 122 – BP 161/133)
- 1850: Pt intubated (121 – 155/133)

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RSI: Rapid Sequence Intubation

- Emergency airway management technique resulting in rapid unconsciousness through the use of a sedation agent immediately followed by paralysis through the use of neuromuscular blockade.
  1. Preparation (position, oxygenation, pretreatment)
  2. Sedation (ketamine, etomidate, versed, propofol)
  3. Paralytic (succinylcholine, rocuronium, vecuronium)

MCC: Referring Facility

- 1854: 103 – 157/133
- 1855: 104 – 48/23
- 1859: O-neg PRBCs (#1) infusing
- 1900: 96 – 89/59
- 1904: TXA bolus
- 1911: NS (#3) started
- 1915: 103 – 18 – 98/55

TXA: Tranexamic Acid

- Synthetic derivative of the amino acid lysine – inhibits fibrin degredation ➡ **Stabilizes clot formation**
- Used in managing significant hemorrhage in the trauma patient, especially in those requiring multiple transfusion of blood products.
- Inclusion/exclusion criteria
- Bolus dose given - followed by maintenance infusion over 8 hrs

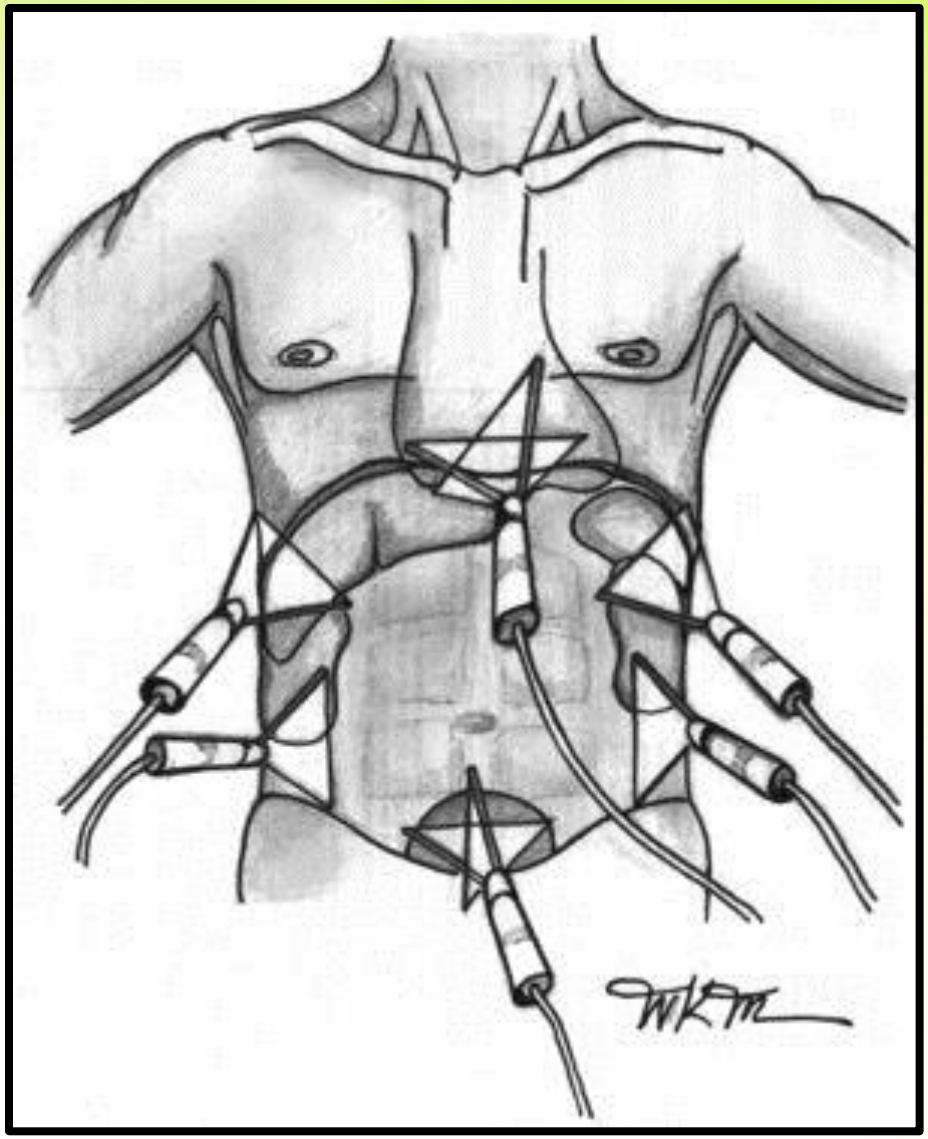
MCC: Referring Facility

- 1920: PRBCs (#2) started
- 1923: NS (#4) started 97.7 – 96 – 12 – 102/66
- 1928: Posterior exam – backboard removed
- 1930: Pressure dressing to leg
- 1934: FFP (#1)
- 1936: NS (#5), FAST exam 96 – 78/54
- 1938: PRBCs (#3)

FAST Ultrasound

FAST

- Focused assessment with sonography for trauma - free fluid in abd
- 5 areas of focus:
  - Perihepatic
  - Perisplenic
  - Pelvic (bilateral)
  - Pericardial



Careflight (1948 – 2112)

- 1948: Sedated/intubated. C-collar present. R)forehead lac. Lung sounds = present. Crepitus L)chest. Abd soft. Pelvis stable. L)lower extremity fx/partial amputation. Large amount blood present on sheets. 2 tourniquets & pressure drsg. No pulses L)foot.
- 1959: To ambulance
- 2002: 72/33
- 2005: PRBCs (#4)

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Careflight (1948 – 2112)

- 2006: Pt moving – ketamine given
- 2015: Pt loaded into fixed wing **81/45 - 104**
- 2030: PRBCs (#5) started **78/51**
- 2035: Ketamine & Fentanyl
- 2050: PRBCs (#6 & 7) **91/44 - 102**
- 2102: Land in SF
- 2112: McK ED – Level I Trauma Team, Massive Transfusion Protocol Activated

Level I Trauma Team Activation Criteria

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MCC: McKennan

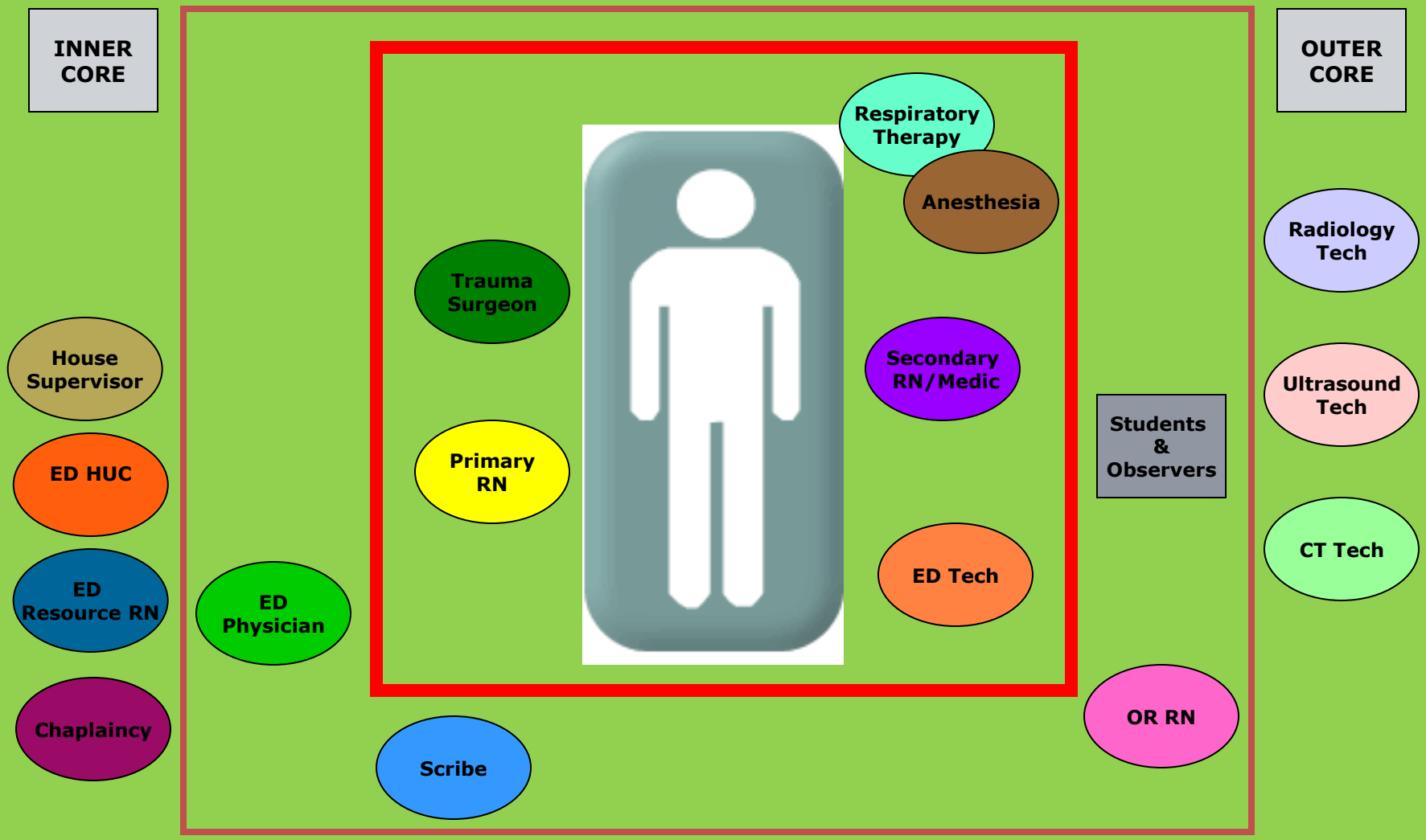
Physiological Parameters:

- ❒ SBP < 90 mmHg at any time in adults & children > 10 years
  - Age specific hypotension in children:
    - SBP = 70 + 2X age in years
    - Additional pediatric clinical criteria for consideration:
      - Level of consciousness
      - Peripheral pulse - quality, character
      - Skin perfusion
- ❒ Respiratory rate < 10 or > 29
- ❒ Heart Rate > 120
- ❒ Glasgow Coma Scale < 10 with Mechanism Attributed to Trauma

Anatomic Parameters

- ❒ Respiratory Compromise/Obstruction ~ **ANY** Intubated Patient
- ❒ Hangings & Drownings with Airway Compromise require Level I Trauma Team Activation with Admit to Trauma as Primary
- ❒ Penetrating Trauma to the Head, Neck, Torso (Chest, Abdomen, Posterior Surfaces) or Groin
- ❒ Transfer Patients Receiving Blood to Maintain Vital Signs
- ❒ Unstable Pelvic Fracture
- ❒ Flail Chest
- ❒ Spinal Injury with Paralysis &/or Neurological Deficits
- ❒ Burns > 20% or involving Face or Airway
- ❒ Amputation Proximal to Wrist or Ankle
- ❒ Two or More Proximal Long Bone Fractures (Humerus, Femur)
- ❒ Emergency Medicine Physician Discretion

Avera McKennan Hospital Trauma Service
Level I Trauma Team Response



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McKennan Massive Transfusion Protocol

- Hemodynamic instability and/or >= 6 units PRBCs within four hours
- Pt requires the need to replace 50% of blood volume within 2-3 hrs

MTP Pack #1	MTP Pack #2	MTP Pack #3
PRBC- 6 units	PRBC- 6 units	PRBC- 6 units
FFP- 4 units	FFP- 4 units	FFP- 4 units
	Platelets- 6 pack	Platelets- 6 pack

Coagulopathy & IV Fluids

- Analysis using the German Trauma Registry Database: 8,724 patients
  - Coagulopathy present in 34.2% of ALL trauma patients

IV Fluid Amount	Incidence of Coagulopathy
<500 cc	10%
>2000 cc	>40%
>3000 cc	>50%
>4000 cc	>70%

Coagulation defined by PTT < 70% and/or platelets < 100,000

Injury (2007).

MCC: McKennan

- 2122: 97.9 – 102 – 25 – 96% ETT – 68/47
  - L)leg drsg blood soaked, + femoral pulses
- 2129: PRBCs (#8 & 9), NS (#6) started on rapid infuser
- 2130: Portable chest x-ray
- 2132: FAST exam
- 2135: Femoral artline placed
- 2142: Pt moving – fentanyl & versed

PTD #	Platelets
0	125
1	97
2	99
3	122
4	175

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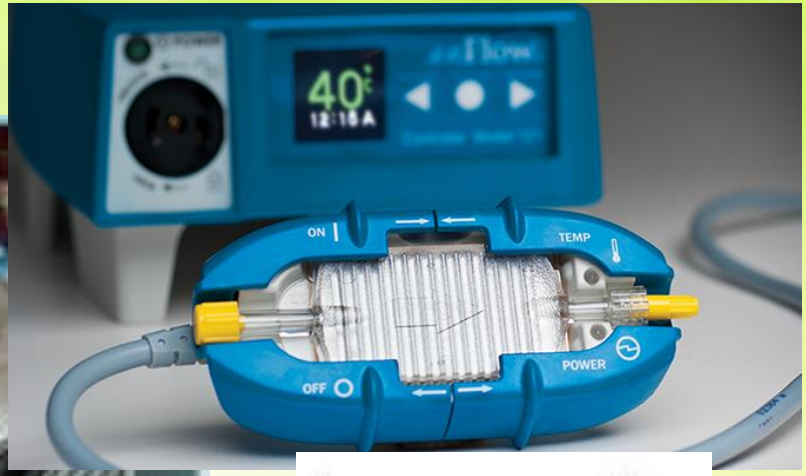

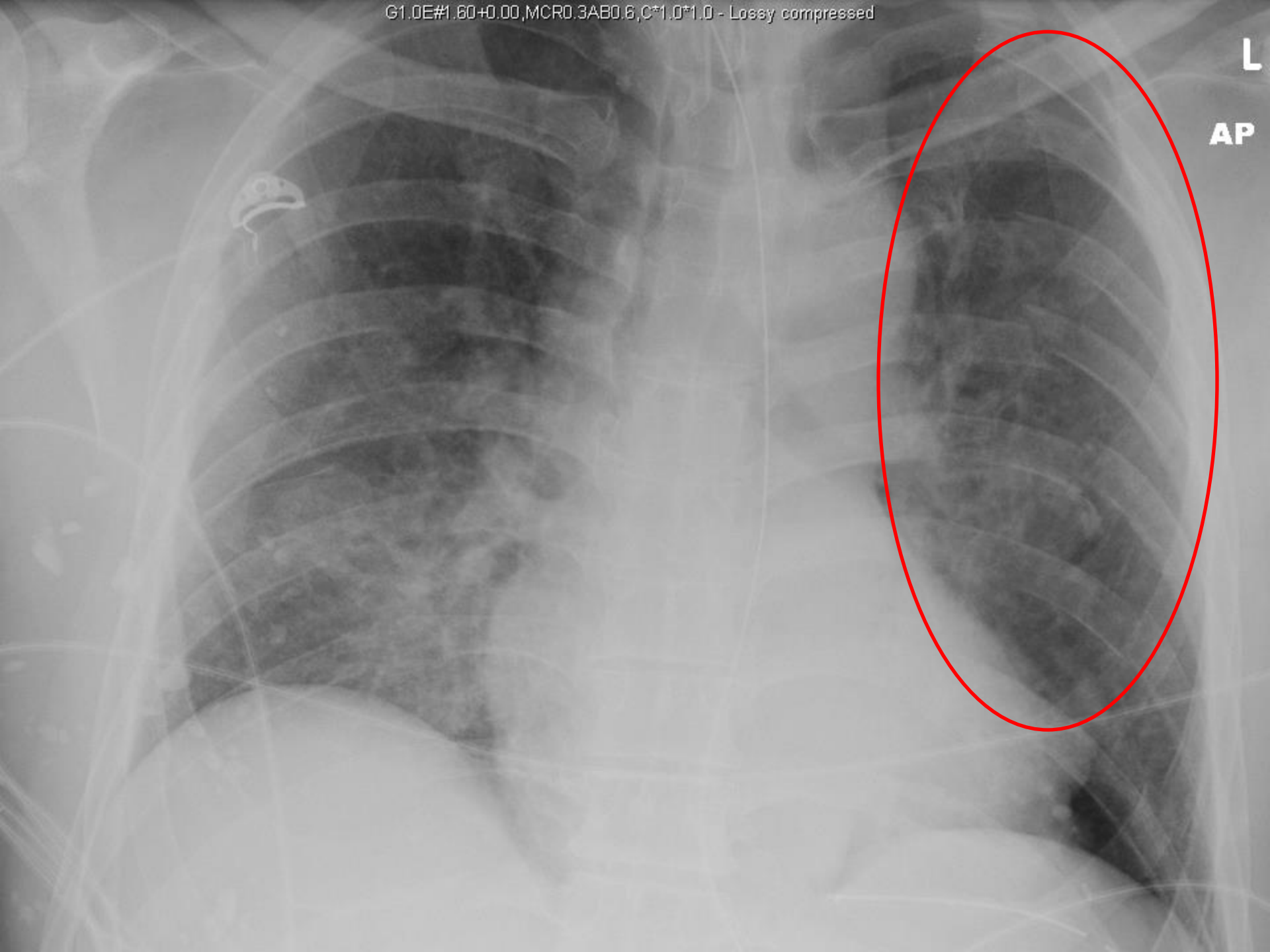
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- 2132: FAST exam
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- 2142: Pt moving – fentanyl & versed, FFP (#2 & 3)

MCC: McKennan

- 2144: L)leg examined – tourniquet not tight: re-dressed & tourniquet tightened
- 2150: PRBCs (#10 & 11) **93/77 96**
- 2154: NS (#7)
- 2159: FFP (#4) – bleeding now controlled
- 2200: FFP (#5) – x-ray to L)leg
- 2214: To CT **131/87 102**
  - Fentanyl & versed in CT

Identified Injuries

- R) eye lac
- Abrasions
- L)pneumothorax
- L) rib fx's 1-9 with flail
- R) rib fx's multiple
- Bilateral pulmonary contusions
- L)lower extremity compound open fx
- R)orbit fx
- T4-T7 spinous process fxs
- L)mandible fx
- L)AC joint separation
- PMH: Hepatitis C

ISS: 29
Ps: 0.274


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bula
Medial Tibial
bula
Normal


L
Actual patient

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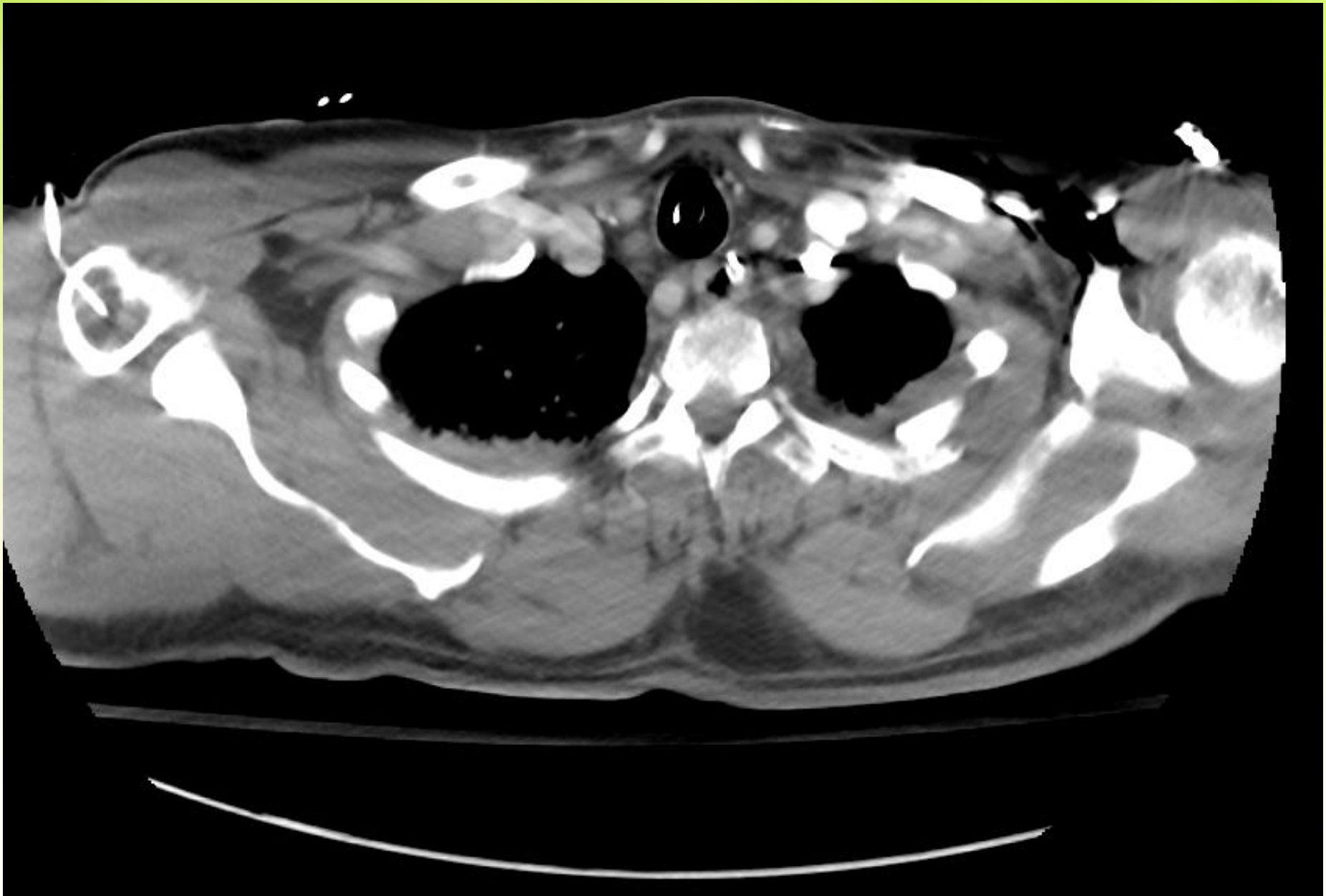

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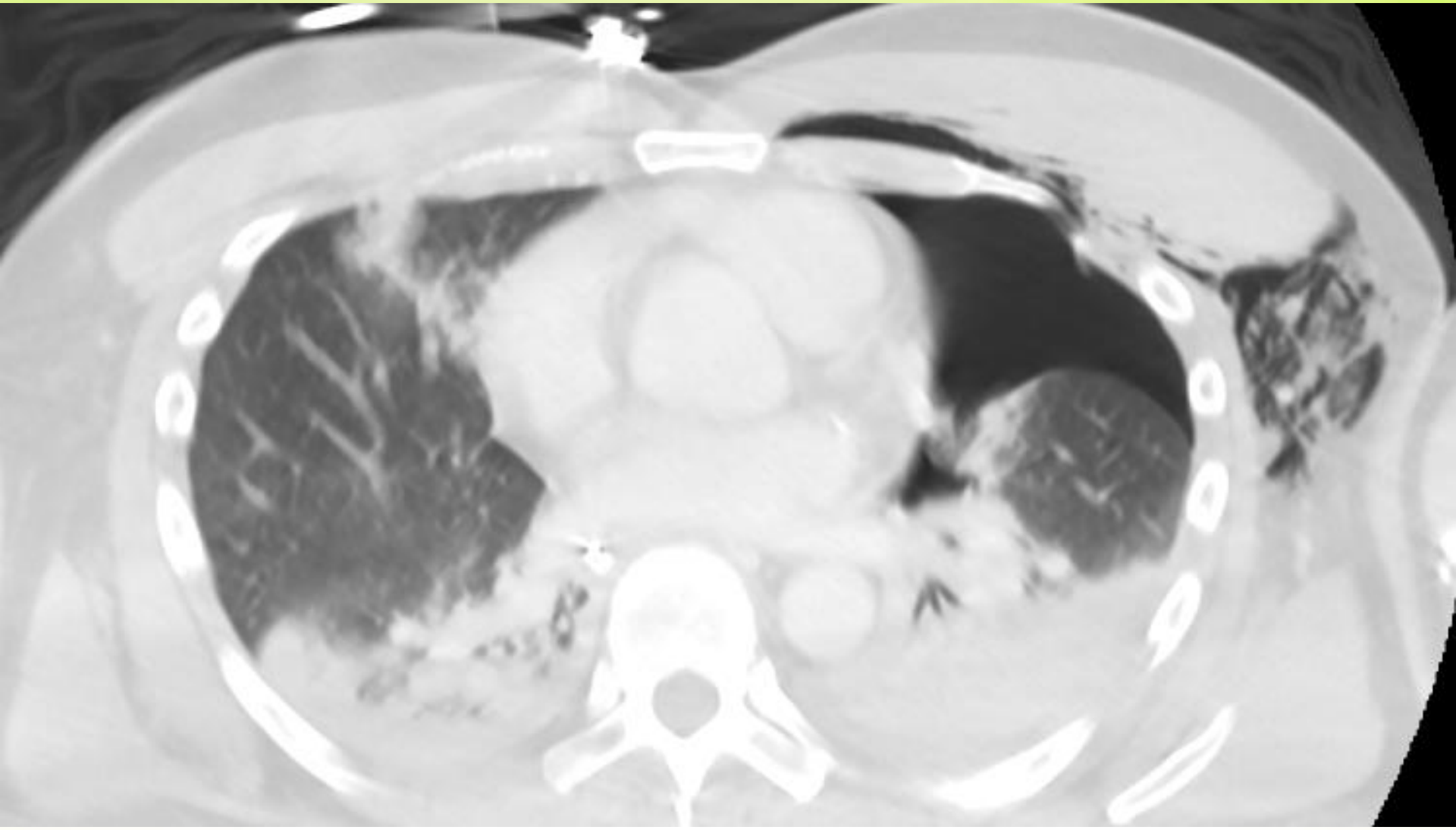
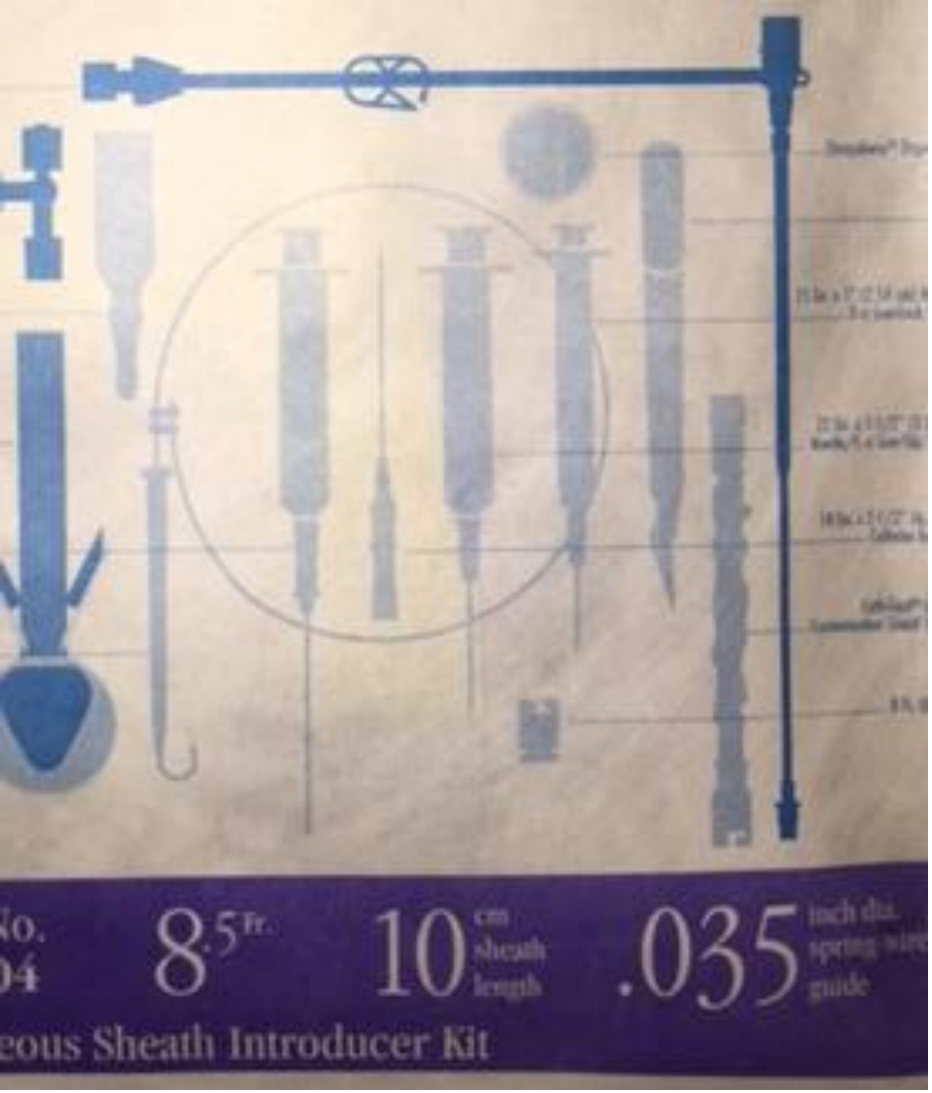


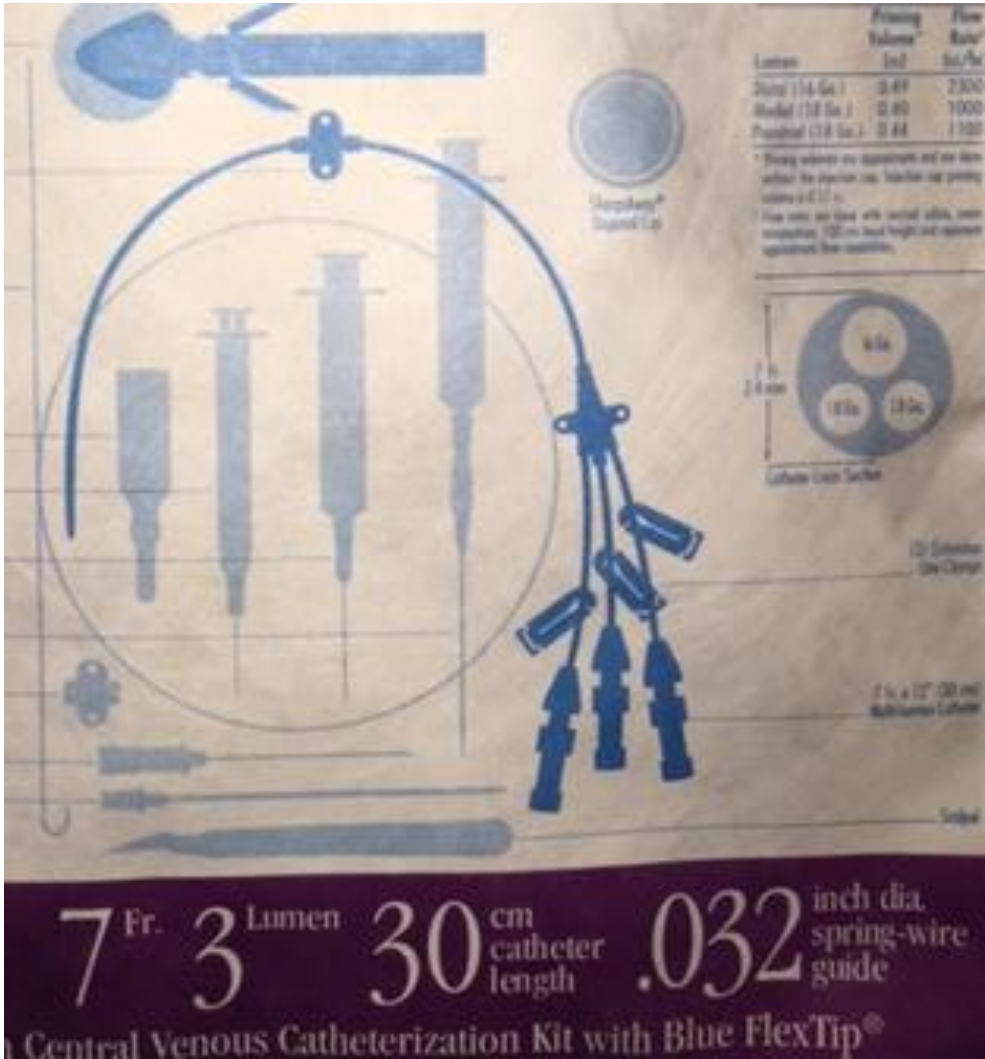
MCC: McKennan

- PTD #0-1: (ICU)
  - L) Chest tube placed
  - Central line placed
  - 0020: To OR
    - L) traumatic above the knee amputation with wound vac placement
    - PRBCs (#12 & 13)
  - Facial laceration repair



Trauma Cortis
Or
"Introducer"

Central Line
(triple lumen)



MCC: McKennan

- PTD #2-6
  - Remains intubated, VSS
  - PTD #3: Return to OR – I & D L)stump
  - PTD #4: Extubated, L)chest tube removed
  - PTD #5: Respiratory distress- tx to ICU & re-intubated, L)chest tube placed
  - PTD #6: Extubated
- PTD #8: Tx to floor
- PTD #16: Tx to Rehab

MCC: McKennan

Performance Improvement

Anything that we could do differently to improve care?

60 y/o male fell 20 feet landing on buttocks. 10 sec LOC. Pt was on a ladder in a tractor bucket.

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51 y/o male who slipped and fell on his icy driveway and striking the back of his head.

Case Study #2
Fall

84 y/o male was ambulating from the bathroom, tripped and fell striking his left side against the bedpost.

82 y/o male un-witnessed ground level fall outside

80 y/o female feet tangled in O2 tubing and fell backwards landing on head (On coumadin)

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Fall

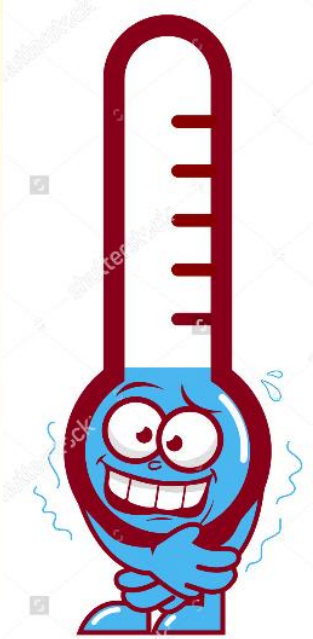
- 51 y/o male who slipped and fell on his icy driveway, striking the back of his head.
  - Positive LOC – 20 minutes
- Referring Facility (1232 – 1523)
  - 1236: 97.1 – 93 – 22 – 106/79 – 92% on RA GCS 14
  - 1242: IV started, warm blankets
  - 1248: Head CT

Fall

- Referring Facility (1232 – 1523)
  - 1328: Return from CT – nauseated
  - 1343: 106 – 18 – 100% on non-rebreather
    - Restless, trying to sit up in bed - ativan
  - 1415: Transport @ beside
  - 1500: RSI
  - 1523: To McKennan

Fall

- Ground Transport (1415 – 1800)
  - 1520: **94.0** - 16 - 119/58 - 99 - 95% via vent - GCS 3
  - Fentanyl, propofol, ativan, vecuronium PRN
  - 1712: 149/82 – 15 - 107



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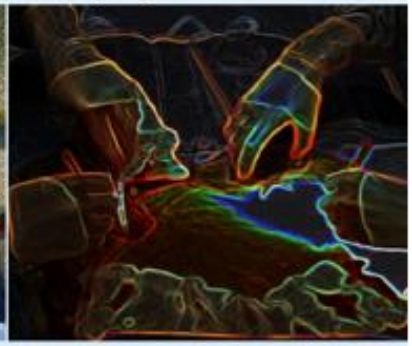
What was the cause of this patient's hypothermia?

Causes

On scene	During transport	Admission / work-up	Surgery / intervention
			
• Environment • Extrication • Entrapment • Exposure	• Environment • Exposure • Anaesthesia/ sedation • Fluids	• Environment • Exposure • Anaesthesia/ sedation • Fluids • Transfusions	• Environment • Exposure • Anaesthesia/ sedation • Fluids • Cavity exposure

Ongoing bleeding and shock

Exposure

i.v. fluids

Medications (sedation/anesthesia)

Soreide (2014).

Pitfalls in the Trauma Bay

- Not checking/documenting a temperature
- Not warming IV fluids and/or blood products
- Over-exposure

Gerecht (2014).

Hypothermia

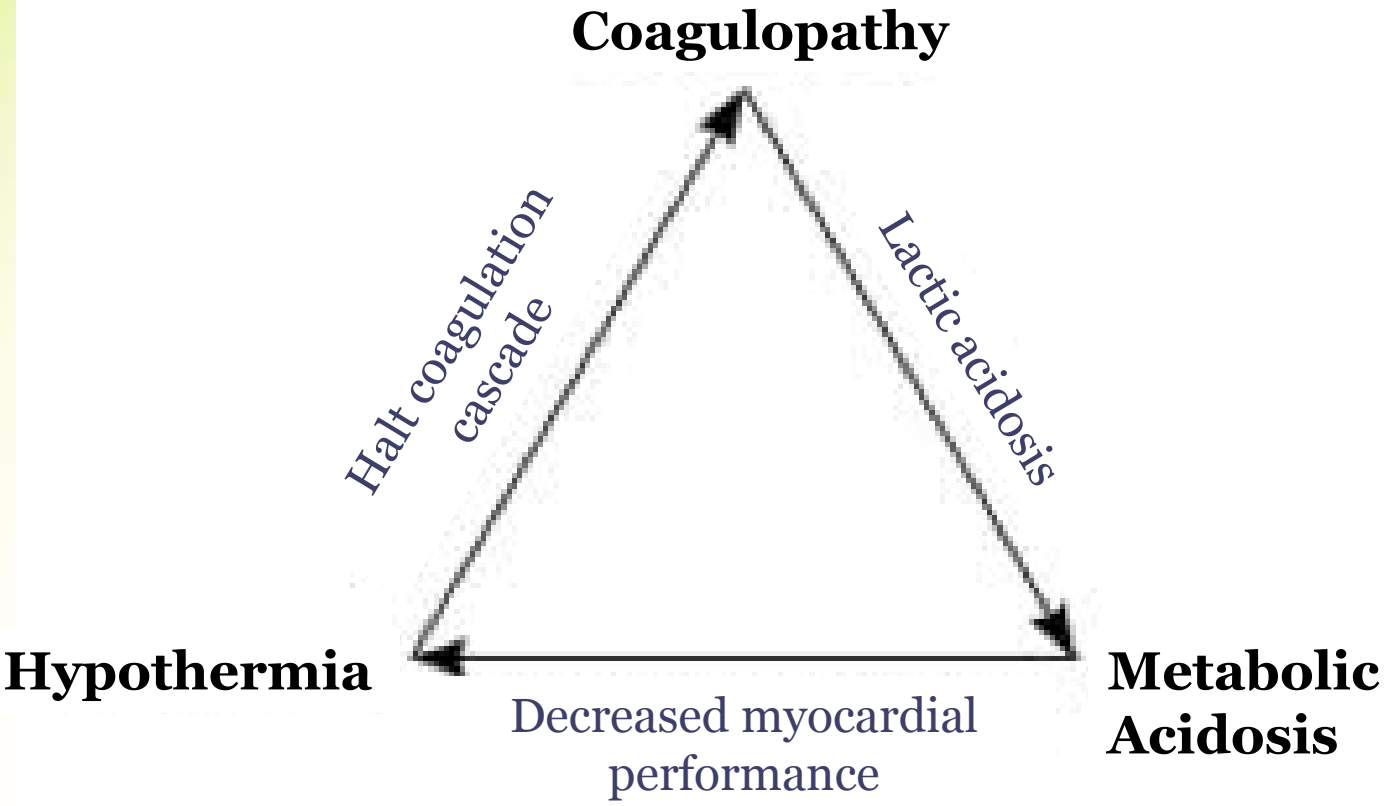
Cardiovascular	Decreased cardiac output and myocardial ischemia
	Decreased cardiovascular response to catecholamines (epinephrine)
	Impaired tissue oxygen delivery
	Arrhythmias such as atrial fibrillation and v fib

Infection	Decreased number and function of white blood cells
	Increased risk of wound infection, pneumonia and sepsis

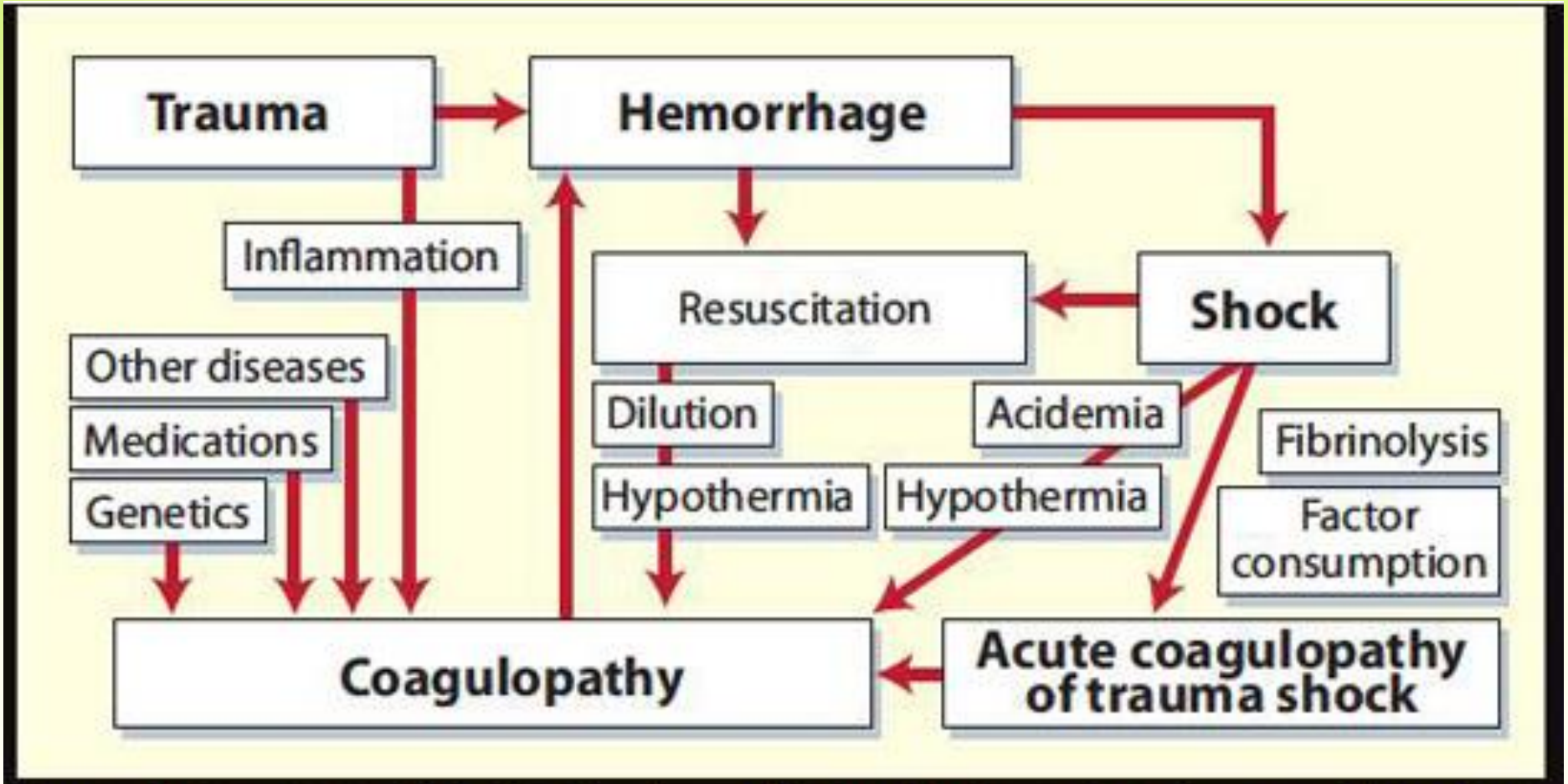
Bleeding	Decreased function of coagulation factors and platelets to make clot and thus stop hemorrhage

Gerecht (2014).

Trauma's Lethal Triad



Lethal Triad & Other Aspects



Recreated figure from Sihler KC, Napolitano LM. Complications of massive transfusion. *Chest*. 2010;137(1):209–220.

Fall

- Avera ER (1813-1920)
  - Level I Activation
  - Restless, combative and biting tube. Propofol gtt re-initiated
  - 1820: 101.4 – 104 – 183/126 – 20 – 97% on ventilator
  - 1830: FAST exam
  - 1857: CT scan
- 1920: Transfer to ICU

Fall

- Injuries:
  - Lt. temporal skull base fracture and adjacent occipital calvarium fracture with trace pneumocephalus
  - IVH
  - SDH
  - Countercoup parenchymal contusions
  - Pulmonary Contusion
  - L) rib fx 5-7
- Co-Morbidities:
  - HTN
  - GERD
  - OSA

ISS: 19
Ps: 0.986

Fall

- PTD #0
  - EVD / ICP placed at bedside
  - No SCD's or chemical prophylaxis
- PTD #2
  - Extubated
  - MAE appropriately, follows commands
- PTD #4
  - Transfer to Neuro Acute

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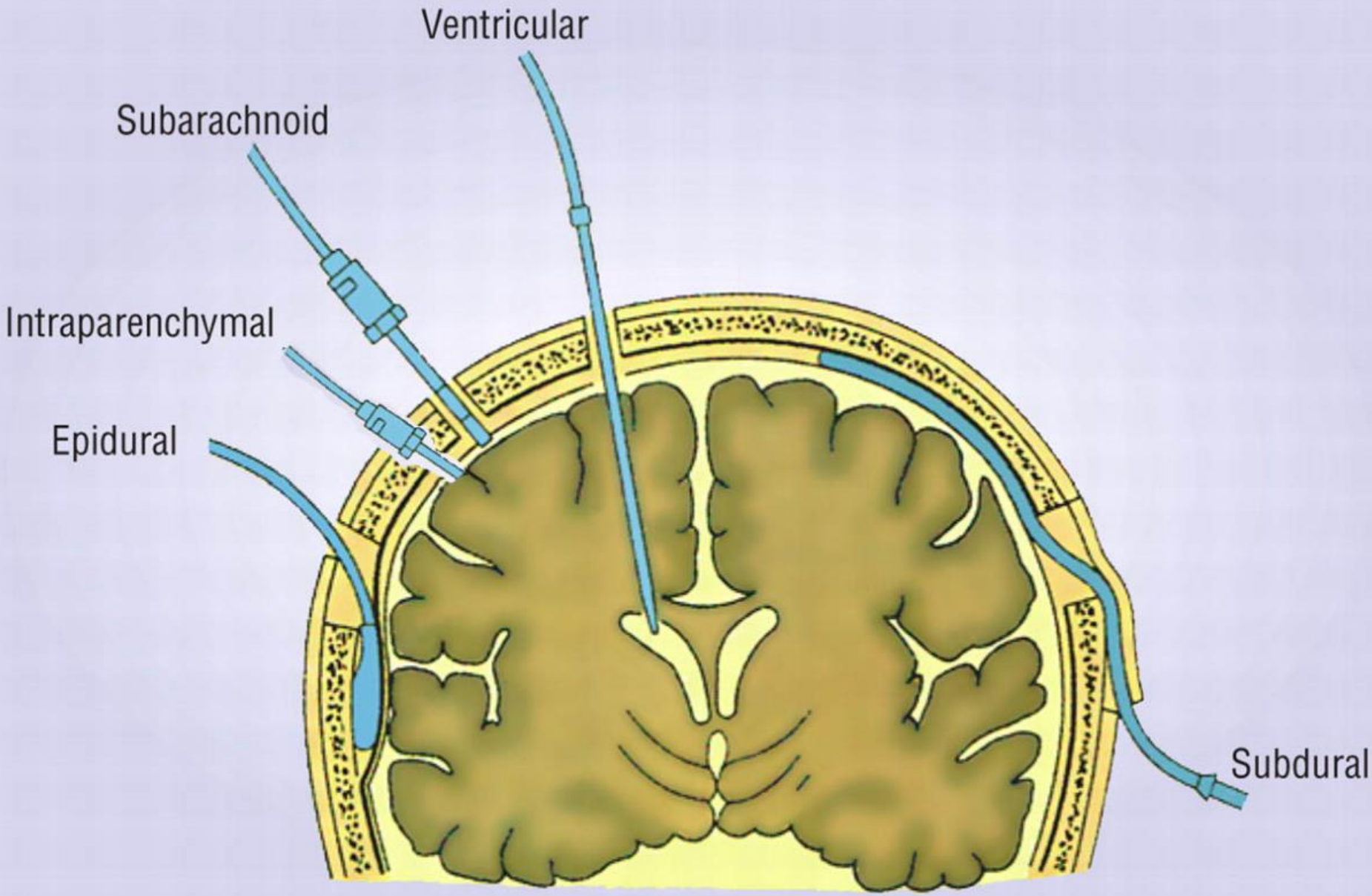

Adapted from Kerr and Crago,[33] with permission from Elsevier.

Fall

- PTD #0
  - EVD / ICP placed at bedside
  - No SCD's or chemical prophylaxis
- PTD #2
  - Extubated
  - MAE appropriately, follows commands
- PTD #4
  - Transfer to Neuro Acute

Fall

- PTD #9
  - Scheduled to move to Avera Rehab. Acute onset of SOB: increased HR / BP, increased O2 demands with a temp of 103.0
  - CT chest: bilateral PE's, dopplers (+) for bilateral DVT's, Heparin gtt started
  - Transfer to ICU
  - No SCD's or anticoagulation since admission

Fall

- PTD #10
  - IVC placement
- PTD #12
  - Transfer to Neuro / Lovenox started
- PTD #14
  - Internal Medicine is now primary

Fall

- PTD #15
  - Coumadin started
- PTD #21
  - Discharged to McKennan Rehab
  - Coumadin / Lovenox

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Fall

Performance Improvement

Anything that we could do differently to improve care?

Case Study #3
MCC

MCC

- **0558**: EMS dispatched
- 50 y/o male. “EMS called to scene for a patient who had an apparent allergic reaction”. Found in ditch sitting up next to motorcycle (handlebars bent & windshield broken).
  - Pt called family member around 0500. Family went looking and found pt then called EMS @ 0558.

MCC: EMS

- 0604: At scene
  - Facial swelling
  - Purple nipple line & up
  - Difficulty breathing
  - Abrasions to R)side & front
  - Pt states he “blacked out” & allergy to bee stings
  - GCS 15 - HR 114 – RR 30

MCC: EMS

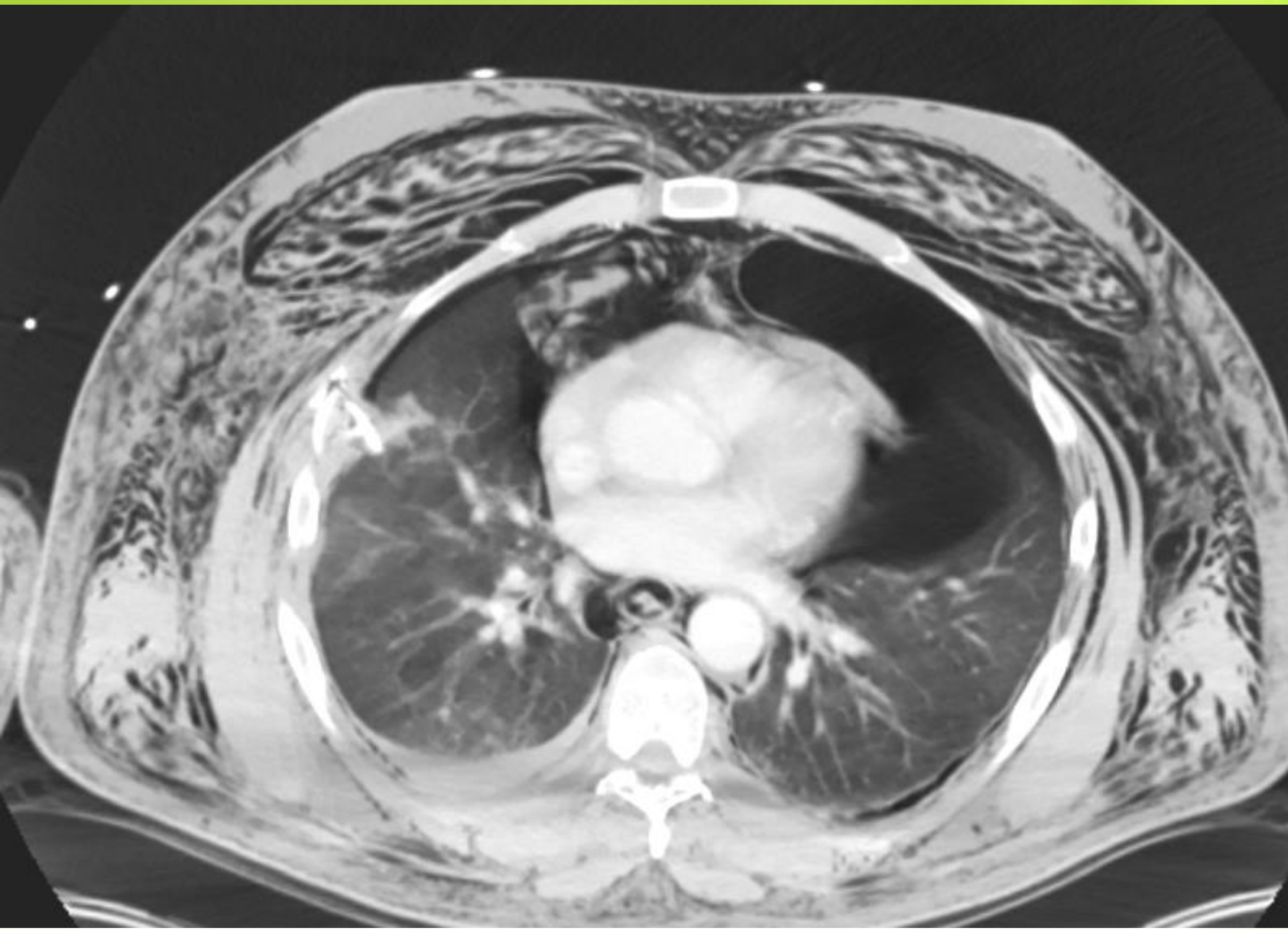
- 0606: Called for ALS intercept
- 0614: En route to hospital
- 0615: Epi given, O2 NRB applied
- 0623: ALS intercept
  - 210/145 – 24 – 124 – GCS 15
  - c/o shortness of breath, speaks in short bursts
  - Attempts to sit up and remove mask
  - Abrasion noted to L)arm and small red mark on back

MCC: EMS

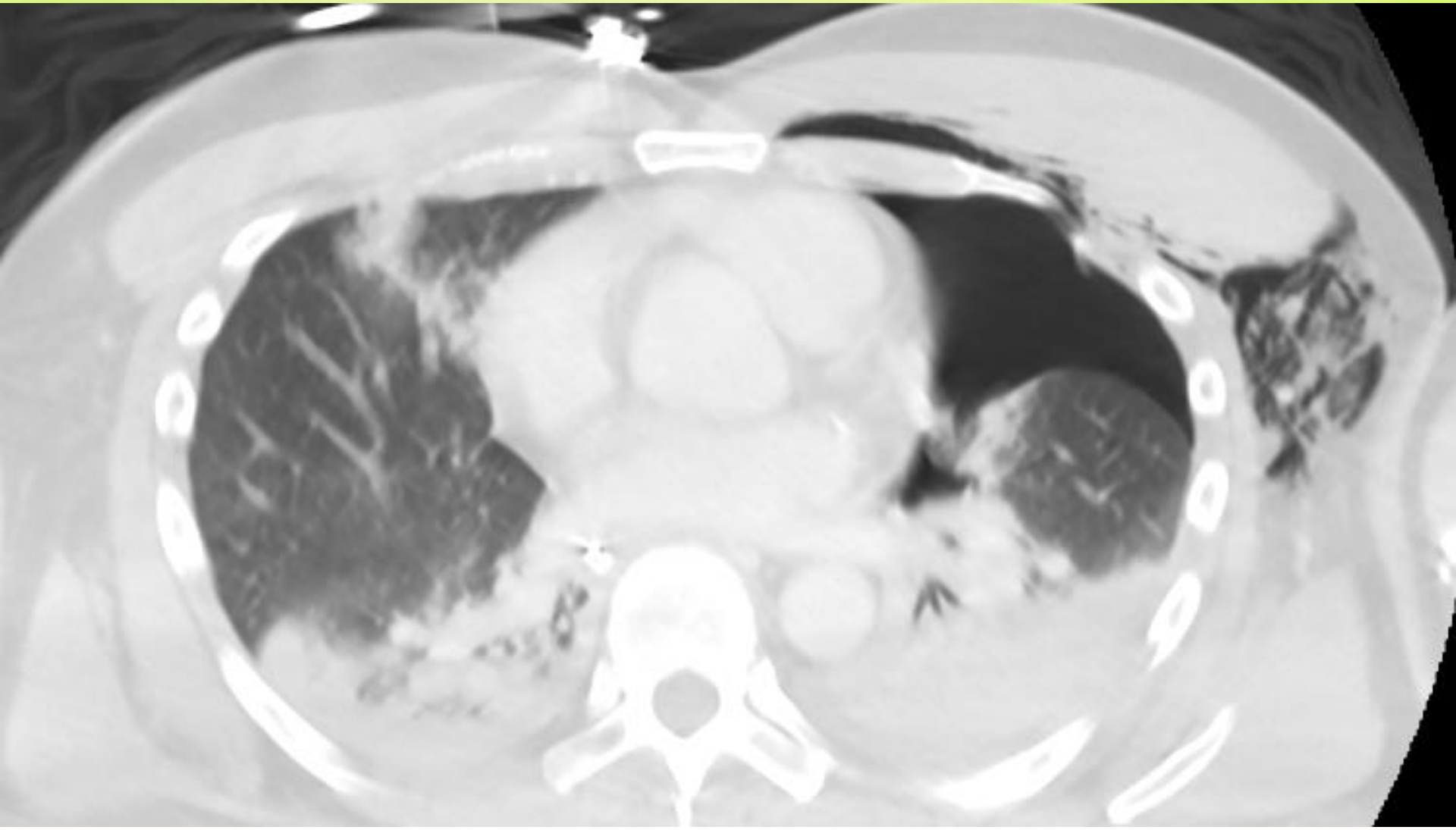
- 0625: IV established
- 0628: Benadryl IVP
- 0635: 202/141 – 28 – 124 – GCS 15
- 0645: At referring facility

MCC: Referring Facility

- 0649: 98.2 – 123 – 24 – 100% NRB – 192/107 - GCS 12
  - Pt restless, sub-q emphysema from head to top of legs, stridor
- 0700: C-collar applied
- 0705: Chest x-ray obtained
- 0715: To CT scan



Avera



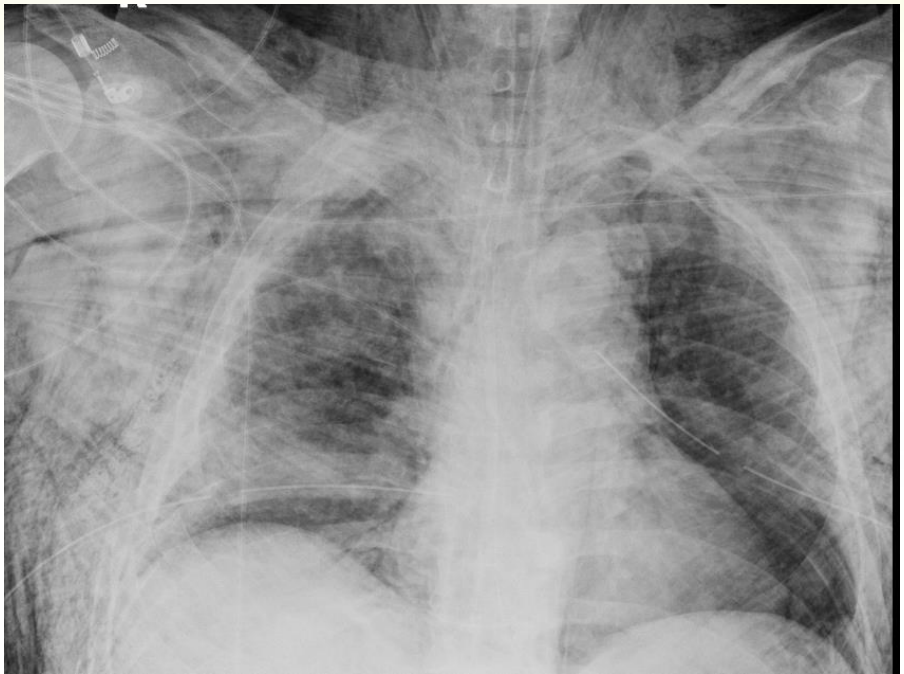
MCC: Injuries

- Pneumothorax L > R
- Hemothorax
- Pulmonary contusion RLL
- R) Rib fx 1-9
- Mediastinal hematoma
- L) Fibula fx
- AC separation – grade 4

ISS: 13
Ps: 0.9641

MCC: Referring Facility

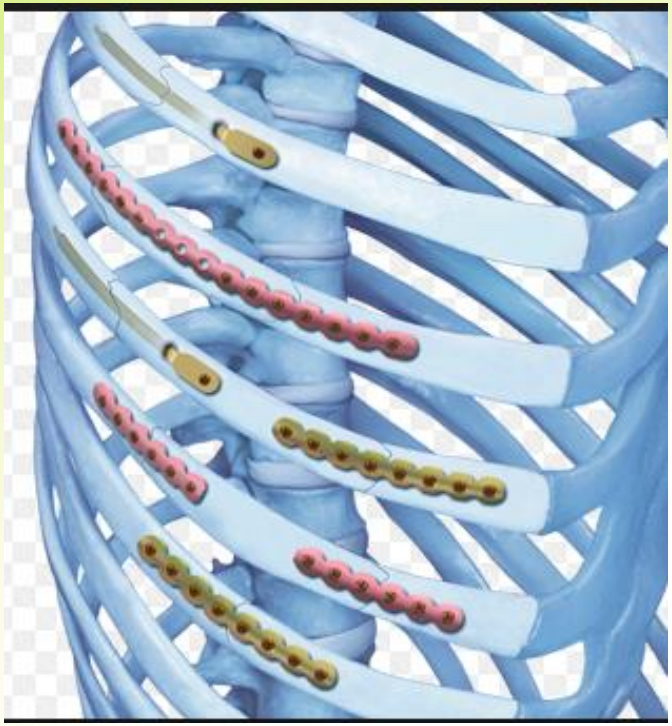
- 0740: Return from CT
- 0750: 126 – 25 – 194/116 – 100% NRB
- 0755: RSI
- 0800: Bilateral chest tubes placed



MCC: Careflight

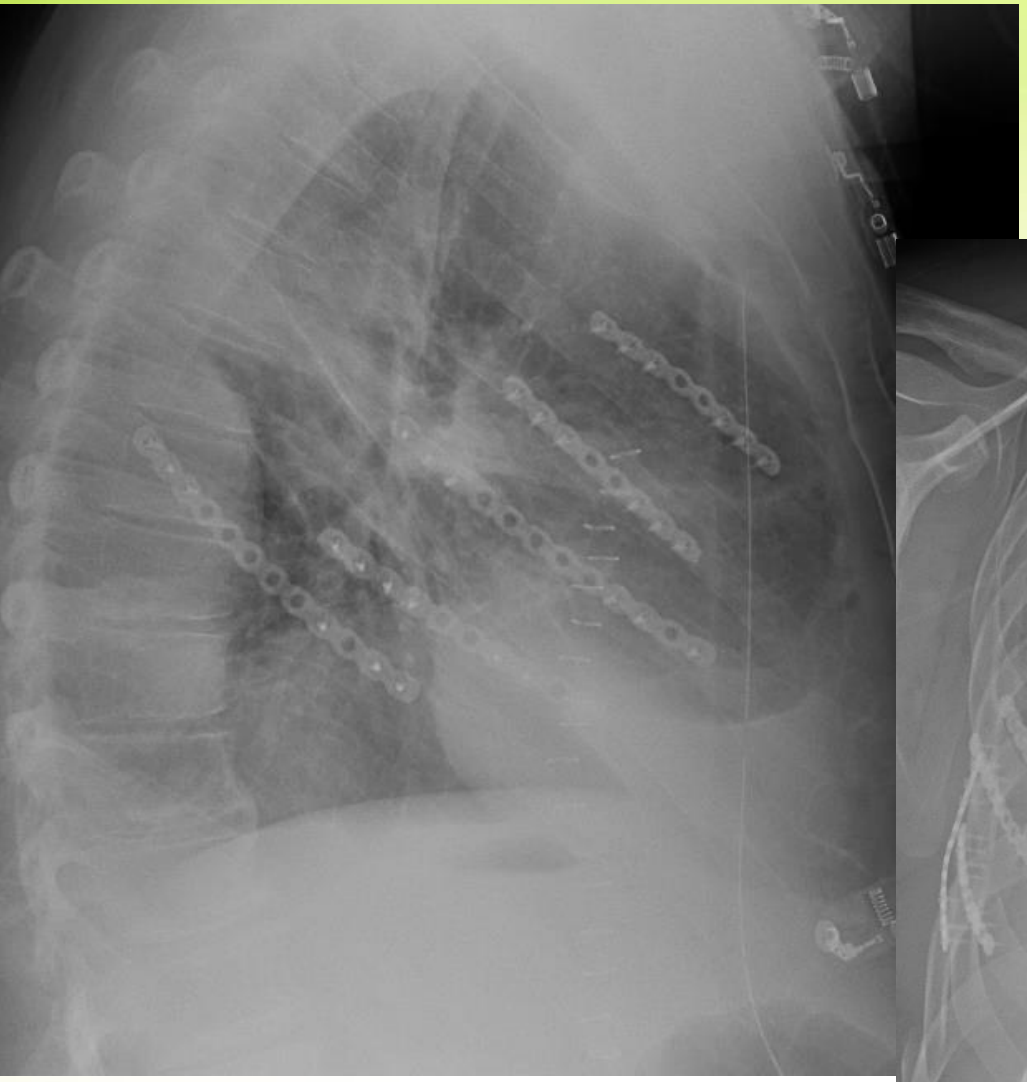
- 0810: Intubated, bilateral chest tubes in place
  - Sub-q emphysema head to toes
  - Abrasion to anterior neck, R)shoulder, upper mid abdomen, R)flank & L)foot
- 0828: Lift for Sioux Falls
  - VSS, receiving sedation, pain rx
- 0902: Level I Trauma Team @ McKennan

MCC: McKennan



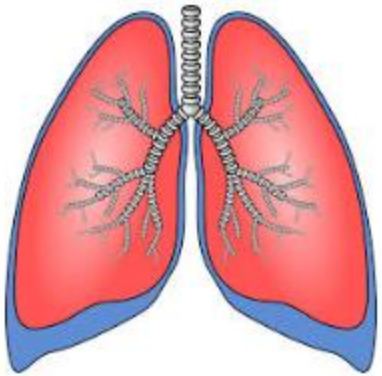
- PTD #1: Pt extubated
- PTD #2: Epidural placed
- PTD #5: Pain with ambulation, x-ray taken (fibula fx)
- PTD #8: Retained hemothorax
- PTD #10: To OR: Thoracotomy with rib fixation and evaluation of hematoma

Rib Fixation

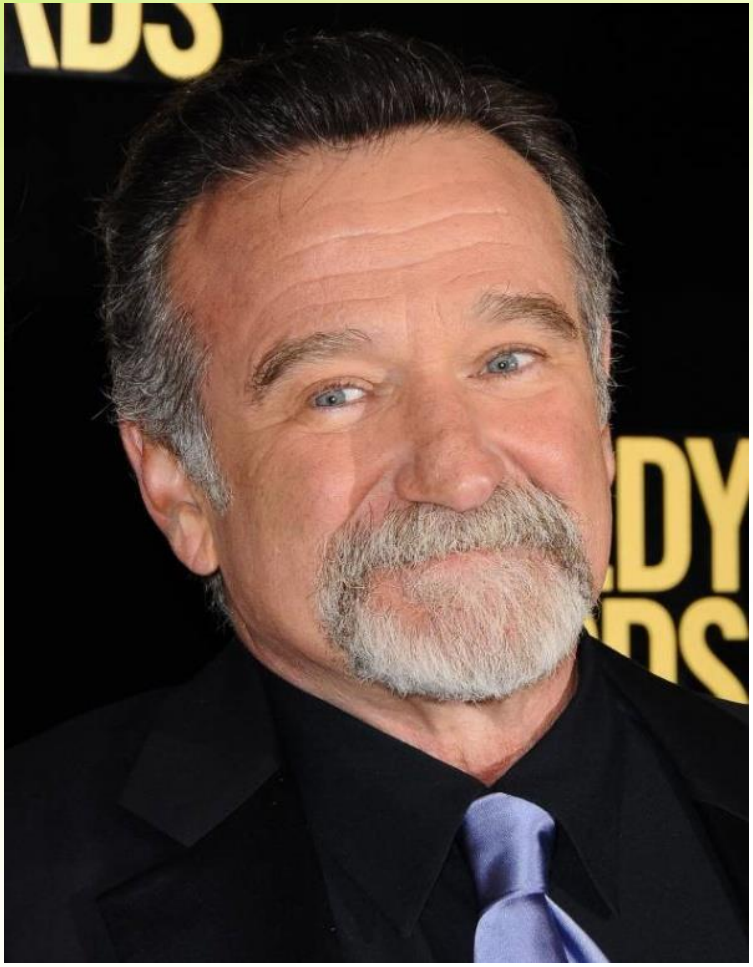


MCC: McKennan

- PTD #15: Retained hemothorax con't. IR placed chest tube
- PTD #20: Chest tube con't. to have drainage. O2 demands decreased.
- PTD #22: Chest tube removed. Pt on room air
- PTD #23: Discharge to rehab on room air, ambulating



Things are not always what they seem…



MCC: McKennan

Performance Improvement

Anything that we could do differently to improve care?

Pitfalls

- Temperature / Respiratory rate monitoring
- Getting patients undressed > FULL assessment
- IV fluid administration
- Ratio based resuscitation
- Activation > undertriage
- Charting
  - EMS reports > please send a copy!

Questions??

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